and create a partial vacuum in the hydrogen storage vessel. In some instances, it may be desirable for the vacuum to develop.

[0017] The invention may provide a means to fill the vacuum by either supplying gases other than hydrogen such as argon, air or nitrogen or provide hydrogen to be provided to the cooling material from an auxiliary hydrogen supply. The gases other than hydrogen may be supplied or air may be intentionally allowed to leak into the vessels as they cool.

[0018] The auxiliary hydrogen supply may be connectible to the respective emptied hydrogen storage vessel when the energy delivery system to the hydrogen storage vessel is deactivated or may alternatively be a small amount of the supplied hydrogen taken off a branch outlet to the supply and returned to the vessels.

[0019] When an auxiliary hydrogen supply is provided, an amount of hydrogen is fed into the emptied hydrogen storage unit to prevent a vacuum being created. At pressures below the operating pressure for desorbing hydrogen, the kinetics for absorbing hydrogen reduces dramatically. It is preferred that the auxiliary hydrogen supply, supply hydrogen to the emptied hydrogen storage unit to maintain the pressure in the hydrogen storage vessel at atmospheric or slightly above atmospheric pressure in order to prevent leaks forming in the hydrogen storage unit and air entering the unit.

[0020] As mentioned above, the auxiliary hydrogen supply may be an auxiliary hydrogen conduit from the supply line to at least the hydrogen storage vessel which has been deactivated. The hydrogen storage conduit preferably has a pressure control valve to supply hydrogen to the deactivated hydrogen storage vessel at a pressure lower than the pressure in the supply line and preferably at atmospheric to 2 bara (or slightly above atmospheric pressure). In one embodiment, the pressure control valve is a step down valve. Alternatively, the auxiliary hydrogen supply may be a secondary hydrogen storage cylinder such as a hydrogen gas cylinder supplying gas at a pressure of between atmospheric and two atmospheres to maintain the pressure in the deactivated hydrogen storage unit at a pressure positive to atmospheric pressure.

[0021] To further limit the amount of hydrogen reabsorbed into the cooling emptied hydrogen storage cylinder, the rate of cooling of the hydrogen storage material may be increased by improving the cooling of the emptied cylinder by either or both passive or active cooling of the cylinder. Passive cooling may take the form of removing any external insulation which may be covering the exterior of the cylinder and active cooling may involve the use of an air blower over the exterior surface of the emptied cylinder or the use of a water-cooled jacket.

[0022] In another aspect of the invention there is provided a system for delivering a supply of hydrogen to a hydrogen supply line including:

[0023] one or more hydrogen storage vessels containing solid hydrogen storage material,

[0024] at least one energy delivery system to supply heat to the solid hydrogen storage material in at least one hydrogen storage vessel, the heat being sufficient to desorb hydrogen from the solid hydrogen storage material; and

[0025] a control system to control the timing of activation of the energy delivery system based on the hydrogen demand in the hydrogen supply line, the control system being configured to anticipate a time when hydrogen will need to be supplied from the hydrogen storage vessel to the hydrogen supply line to meet the hydrogen demand, and activate the energy delivery system in the hydrogen storage vessel a period of time prior to the anticipated time to allow the material in the hydrogen storage vessel to heat to the temperature at which hydrogen can be supplied at the supply pressure of the hydrogen supply line to meet the hydrogen demand in the supply line.

[0026] The above invention may be applicable to a single hydrogen storage vessel in having an energy delivery system and control, system. The control system would monitor the demand and activate the energy delivery system in response to variable which indicates that hydrogen from the hydrogen storage vessel will be required to meet the anticipated hydrogen demand.

[0027] However, in a preferred form, the above system includes two or more hydrogen storage vessels containing hydrogen storage material, the control system being configured to anticipate or determine a time when hydrogen supply from a first hydrogen storage vessels will fall below a predetermined level and activate the energy delivery system in a second hydrogen storage vessel a predetermined time prior to the anticipated or determined time to allow the material in the second hydrogen storage vessel to heat to the temperature at which hydrogen can be supplied at the supply pressure of the hydrogen supply line to meet the hydrogen demand in the supply line.

[0028] In the preferred form of this invention, the control system comprises a sensor which monitors a variable of hydrogen supply to the supply line and a processor which activates the energy delivery system in the next sequential hydrogen supply vessel when it determines from signals from the sensor that the hydrogen supply in the hydrogen storage vessel currently connected to the hydrogen supply line has fallen below a predetermined level.

[0029] In another aspect of the invention there is provided a method of supplying hydrogen from a hydrogen delivery system to a hydrogen supply line, the system including one or more hydrogen storage vessels containing solid hydrogen storage material, at least one energy delivery system to supply heat to the solid hydrogen storage material in at least one hydrogen storage vessel, the heat being sufficient to desorb hydrogen from the solid hydrogen storage material; and a control system to control the timing of activation of the energy delivery system based on the hydrogen demand in the hydrogen supply line.

[0030] The method includes the steps of anticipating or determining a time when hydrogen will need to be supplied from the hydrogen storage vessel to the hydrogen supply line to meet the hydrogen demand, and activating the energy delivery system in the hydrogen storage vessel a period of time prior to the anticipated time to allow the material in the hydrogen storage vessel to heat to the temperature at which hydrogen can be supplied at the supply pressure of the hydrogen supply line to meet the hydrogen demand in the supply line.

[0031] As used herein, except where the context requires otherwise, the term "comprise" and variations of the term, such as "comprising", "comprises" and "comprised", are not intended to exclude further additives, components, integers or steps.

BRIEF DESCRIPTION OF THE DRAWINGS/FIGURES

[0032] FIG. **1** is a graph of a typical reaction rate versus temperature curve for hydrogen absorption of a metal hydride